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MEDICAL INJECTION APPARATUS
[Iryoyo chusha sochi]

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Claim

1. A medical injection apparatus characterized in that it is provided with:

an ultrasonic vibrator that generates ultrasonic vibration,

a cover that covers said ultrasonic vibrator,

a probe that is connected to said ultrasonic vibrator and that transmits the ultrasonic vibration generated by the ultrasonic vibrator,

and a needle section that is provided at the tip of the probe and that has an end surface that is cut at a diagonal,

and in that a through-hole that opens at said needle section is provided in said probe, and a socket to which is connected a syringe, inside of which is sealed an injection solution, is provided in said cover so as to connect to said through-hole.

Detailed explanation of the invention

[0001]

Technical field of the invention

The present invention pertains to a medical injection apparatus, and relates in particular to a medical injection apparatus that makes it possible to pierce biological tissue with an injection needle by means of the action produced by ultrasonic vibration.

[0002]

Prior art

Generally, removal of bladder tumors is performed through the urethra with endoscope observation. Such removal surgeries are normally performed in an operating room by administering lumbar anesthesia to reduce pain. In recent years, however, with outpatient diagnosis, bladder tumors are also

being removed through the urethra with endoscope observation in the diagnosis room. In this case, because the removal procedure is not carried out in an operating room, no lumbar anesthesia is administered, and the area of the bladder tumor is often locally anesthetized to reduce pain.

[0003]

The aforementioned local anesthesia is generally administered by puncturing the bladder wall in the vicinity of the bladder tumor with an injection needle that is introduced into the body through the urethra with endoscope observation, and by administering an anesthetic into the tissue in the vicinity of the bladder tumor through the puncturing injection needle. Injection implements used for the administration of an anesthetic in this way are described, for example, in Japanese Kokai Patent Application Nos. Hei 10[1998]-277149 and Hei 10[1998]-85331.

[0004]

Problems to be solved by the invention

The bladder wall, incidentally, is generally quite elastic. Thus, with local anesthesia, even when the injection needle is pressed against the bladder wall to puncture it, the bladder wall stretches due to the pressing force, and it may not be possible to puncture the bladder wall easily with the injection needle. Therefore, the time needed until the anesthetic is administered will be long, and during that period, the patient must tolerate uncomfortable sensations and pain. With outpatient diagnosis in particular, it is not possible to see and treat [just] one patient over a long period of time, so there is a desire for administering quick local anesthesia.

[0005]

The present invention was devised focusing on the aforementioned situation, and the objective is to provide a medical injection apparatus with which even very elastic tissue can be easily punctured with an injection needle.

[0006]

Means to solve the problems

To solve the aforementioned problems, this invented medical injection device is characterized in being provided with an ultrasonic vibrator that generates ultrasonic vibration, a cover that covers the aforementioned ultrasonic vibrator, a probe that is connected to the aforementioned ultrasonic vibrator and that transmits the ultrasonic vibration generated by the ultrasonic vibrator, and a needle section that is provided at the tip of the probe and that has an end surface that is cut at a diagonal. It is also characterized in that a through-hole that opens at the needle section is provided in the aforementioned probe, and a socket to which is connected a syringe, inside of which is sealed an injection solution, is provided in the aforementioned cover so as to connect to the aforementioned through-hole.

[0007]

Embodiments of the invention

Embodiments of the present invention are explained below with reference to the figures.

[0008]

Figures 1-5 show a first embodiment of the present invention. As shown in Figure 1, medical injection apparatus 1 in this embodiment is provided with a tubular sheath 3 that is inserted into the

body, and a manipulating section 2 in which is formed a grip section that is connected to the base of sheath 3 and that is gripped by the practitioner. A tubular injection needle probe 4 is disposed inserted through sheath 3 in a lengthwise orientation.

[0009]

The tip of injection needle probe 4 protrudes from the tip of sheath 3, and a needle section 4a, the end surface of which is cut at a diagonal, is formed. In this case, the end surface of needle section 4a is formed as a diagonal surface that forms an acute angle with respect to the axis of injection needle probe 4. A through-hole 5 is also formed in injection needle probe 4. Through-hole 5 extends the length of injection needle probe 4 with the center of the lengthwise axis of injection needle probe 4 as its axial center. Note that injection needle probe 4 is formed with a material that has excellent acoustic characteristics and a relatively large amount of flexibility, for example, a titanium alloy.

[0010]

As shown in detail in Figure 2 and Figure 3, manipulating section 2 is formed as a hand-piece, and has a tubular cover on which is formed a grip section. The cover is composed of a front case 20 and a rear case 21 that are mutually separable. Specifically, a female thread section 21A that is screwed onto a male thread section 20A formed at the base of front case 20 is formed at the tip of rear case 21, and when female thread section 21A is twisted onto male thread section 20A, rear case 21 and front case 20 are integrally attached. And when female thread section 21A is removed from male thread section 20A, rear case 21 is separated from front case 20 as shown in Figure 3.

[0011]

An ultrasonic vibrator 22 is built into rear case 21. Ultrasonic vibrator 22 has multiple piezoelectric elements 24, etc. Each piezoelectric element 24 is provided held between electrode plates 37 and 37. A wire 26 for supplying current is soldered to each electrode plate 37. Each wire 26 is electrically connected to a generator 7 (refer to Figure 1) that supplies the power required to generate ultrasonic vibration through a cord 6. Therefore, when current is supplied between electrode plates 37 from generator 7 through wires 26, piezoelectric elements 24 expand and contract, and ultrasonic vibration is generated.

[0012]

Note that a footswitch 8 to generate/stop ultrasonic vibration is connected to generator 7, as shown in Figure 1. Cord 6 is also fixedly connected to rear case 21 through a non-bending member 29, as shown in Figure 1 and Figure 2.

[0013]

A horn 23 to amplify the ultrasonic vibration generated by ultrasonic vibrator 22 and broaden the amplitude is joined to ultrasonic vibrator 22. Female threads 32 to which is attached injection needle probe 4 are formed at the tip of horn 23. Male threads 31 formed at the base of injection needle probe 4 are screwed into female threads 32. That is, injection needle probe 4 is detachable from horn 23, and can be separated from horn 23 via threads 31 and 32 as shown in Figure 3.

[0014]

Note that a recessed wrench fastening section 30 in which a wrench, not shown, is fastened is formed in the outside surface around the base of injection needle probe 4. When a wrench is fastened in wrench fastening section 30 and injection needle probe 4 is rotated with respect to horn 23, injection needle probe 4 can be attached to or detached from horn 23.

[0015]

Horn 23 is supported inside rear case 21, along with ultrasonic vibrator 22 that is joined to it, with a clamping nut 38 that is screwed into the inner surface at the tip of rear case 21. Specifically, a flange section 23A protrudes at the base of horn 23, and ultrasonic vibrator 22 and horn 23 are held with respect to rear case 21 by flange section 23A of horn 23 being held between support section 21B, which projects on the inner surface of rear case 21, and clamping nut 38. In this case, a first support rubber piece 25A that absorbs vibration is inserted between support section 21B and flange section 23A. A second support rubber piece 25B that absorbs vibration and ensures water-tightness and airtightness is also inserted between flange section 23A and clamping nut 38.

[0016]

A through-hole 39 that passes through their axial centers is also formed in ultrasonic vibrator 22 and horn 23, and through-hole 39 is made to connect with through-hole 5 in injection needle probe 4 when injection needle probe 4 is attached to horn 23.

[0017]

A tubular syringe socket 27 is affixed to rear case 21. The base of syringe socket 27 projects from the base end (back end) of rear case 21, and forms a socket section to which a syringe 9 shown in Figure 1 is connected. The tip of syringe socket 27 is connected and affixed to ultrasonic vibrator 22, and is connected with through-hole 39 in ultrasonic vibrator 22. An O-ring 28 to ensure water-tightness is inserted between the tip of syringe socket 27 and ultrasonic vibrator 22.

[0018]

Next, the operation of medical injection apparatus 1 with the aforementioned configuration will be explained.

[0019]

When the area of a bladder tumor is locally anesthetized, sheath 3 of medical injection equipment 1 is inserted through channel 14 of insertion section 13 of endoscope 10, while the tip of sheath 3 is used by its protruding from the tip of insertion section 13. In this case, a light-source apparatus 12 is connected to light-guide cable 11 that extends from the manipulating section of endoscope 10. The light applied from light-source apparatus 12 is transmitted to the tip of insertion section 13 through light guide fibers placed inside light-guide cable 11 and insertion section 13, and the object to be observed is illuminated through an illuminating lens 16 placed on the tip surface of insertion section 13. The light reflected from the object to be observed (object beam) is also captured in endoscope 10 through an objective lens 15 placed at the tip surface of insertion opening 13 and is observed as an endoscope image by using an eyepiece section 50.

[0020]

A case when the area of a bladder tumor is locally anesthetized is specifically explained below.

[0021]

First, as shown in Figure 5, while insertion section 13 of endoscope 10 is inserted into the bladder, sheath 3 of medical injection apparatus 1 is very carefully inserted into channel 14 in endoscope insertion section 13. Then, the tip of sheath 3 protrudes from the tip of insertion section 13 while the tip of insertion section 13 is positioned facing bladder wall 18 near bladder tumor 17.

[0022]

Next, before bladder wall 18 is punctured with needle section 4a at the tip of injection needle probe 4, the switch on foot switch 8 is pressed, and current is supplied to electrode plates 37 of ultrasonic vibrator 22 through cord 6 and wires 26 from generator 7. Ultrasonic vibration is thereby generated by the electrostrictive action of piezoelectric elements 24, and while the ultrasonic vibration is expanded to the desired amplitude by horn 23, [ultrasonic vibration] is transmitted to needle section 4a at the tip of injection needle probe 4. At this time, if injection needle probe 4 is accidentally touched, there is the risk of the inner surface of channel 14 being damaged, or of unnecessary damage being caused to the biological tissue, but because the outside of injection needle probe 4 is covered by sheath 3, such a situation can be prevented.

[0023]

Next, bladder wall 18 near bladder tumor 17 is punctured with needle section 4a to which ultrasonic vibration is being transmitted. In this instance, rather than needle section 4a being released, it will smoothly puncture bladder wall 18, which is very elastic, due to the action of the ultrasonic vibration.

[0024]

After needle section 4a has punctured bladder wall 18 to a prescribed depth, then syringe 9 that contains an anesthetic is connected to syringe socket 27, and piston 9A of syringe 9 is pushed in the direction of arrow A. Anesthetic 19 is thereby injected into bladder wall 18 through syringe socket 27 and through-holes 39 and 5 in ultrasonic vibrator 22 and injection needle probe 4.

[0025]

In medical injection apparatus 1 in this embodiment, injection needle probe 4 can puncture tissue due to the action of ultrasonic vibration, so that although puncture capability does not drop significantly, there is the possibility of puncture capability decreasing gradually with repeated use. In this case, it is necessary to remove injection needle probe 4 from horn 23 and replace it. That is, first, screw sections 20A and 21A are loosened to unscrew front case 20 and rear case 21, and rear case 21 is removed from front case 20. Then, a wrench, not shown, is fastened in wrench fastening section 30 of injection needle probe 4, and injection needle probe 4 is rotated with respect to horn 23. Injection needle probe 4 is thereby removed from horn 23, and injection needle probe 4 can be replaced.

[0026]

As explained above, medical injection apparatus 1 of the present invention has ultrasonic vibrator 22 and has a structure such that ultrasonic vibration generated from ultrasonic vibrator 22 is transmitted to injection needle probe 4 and needle section 4a at its tip. Therefore, needle section 4a does not require a strong force, due to the action of the ultrasonic vibration, and will smoothly puncture even tissue that is very elastic. The tip surface of needle section 4a is also cut at a diagonal, so its ability to puncture tissue is even further improved. A syringe socket 27 is also provided at the proximal end of manipulating section 2, so after needle section 4a has punctured the tissue, an anesthetic can be easily administered. When quick local anesthesia can be administered in this way, patient discomfort and pain can be kept to a minimum, and the patient can be moved quickly from anesthetic injection to bladder tumor removal. Therefore, the duration of treatment with outpatient consultation can be shortened.

[0027]

Note that medical injection apparatus 1 in this embodiment is not limited to the treated tissue being bladder wall 18. For example, application to other biological tissues or mucous membranes is possible. In addition, in this embodiment, needle section 4a could also be constructed to be removable from the main body of probe 4. In such a case, a disposable needle section 4a can be used.

[0028]

Figure 6 shows a second embodiment of the present invention. Note that in this embodiment, the constituent elements that are common to the first embodiment have the same symbols and explanations are omitted.

[0029]

In medical injection apparatus 1A pertaining to this embodiment, a socket 33 to which syringe 35 can be connected is provided in the side surface of front case 20. The inside hole in socket 33 joins the gap between the inside of front case 20 and injection needle probe 4. Note that the construction is otherwise the same as the first embodiment.

[0030]

With a construction such as this, when syringe 35 is connected to socket 33 and a cooling fluid 34 that fills syringe 35 is supplied from socket 33, the cooling fluid passes through the gap between sheath 3 and injection needle probe 4 and is discharged from the tip of sheath 3, and it passes through the gap between channel 14 in endoscope 10 and sheath 3 and is recovered in a recovery section that is not shown.

[0031]

Circulation of this type of cooling fluid 34 controls heat generated by injection needle probe 4, which is vibrating ultrasonically, partially contacting sheath 3, and safe injection is enabled. Injection can thereby be carried out multiple times in succession.

[0032]

Note that various constructions as shown below may be obtained with the technical details explained above.

[0033]

1. An ultrasonic injection needle characterized in that, in an ultrasonic unit that has a vibrator that generates ultrasonic vibration, a cover that covers the vibrator, a probe that can elastically deform relatively flexibly and that transmits the ultrasonic vibration, and a through-hole that passes coaxially through the axial center of the vibrator and the probe, the distal end of the probe is in the form of a diagonal surface at an acute angle, and a syringe attachment socket for anesthetic injection is provided at the end of the through-hole in the proximal end of the cover.

[0034]

2. The ultrasonic injection needle described in paragraph 1, characterized in that a sheath that covers the probe portion is provided.

[0035]

3. The ultrasonic injection needle described in paragraph 2, characterized in that the sheath is assembled so as to be detachable.

[0036]

4. The ultrasonic injection needle described in paragraph 1, characterized in that a threaded fastening section is provided in the vibrator and probe connection section, and in that the probe is attached and detached by loosening the threaded fastening.

[0037]

5. The ultrasonic injection needle described in paragraph 1, characterized in that a socket to supply a liquid that circulates in the gap between the sheath and the probe is provided.

[0038]

Effect of the invention

As explained above, with this invented medical injection apparatus, even very elastic tissue can be punctured easily with the injection needle.

Brief description of the figures

Figure 1 is an oblique view of a medical injection apparatus that pertains to a first embodiment of the present invention.

Figure 2 is a cross section of the medical injection apparatus in Figure 1.

Figure 3 is a cross section that shows the medical injection apparatus in Figure 1 disassembled.

Figure 4 is an oblique view that shows the medical injection apparatus in Figure 1 inserted into an endoscope.

Figure 5 is an oblique view that shows how the bladder wall is punctured with the needle section of the medical injection apparatus in Figure 1 through an endoscope.

Figure 6 is a cross section of a medical injection apparatus that pertains to a second embodiment of the present invention.

Explanation of symbols

1, 1A Medical injection apparatus

4 Injection needle probe

5, 39 Through-hole

20, 21 Cover

22 Ultrasonic vibrator

27 Syringe socket

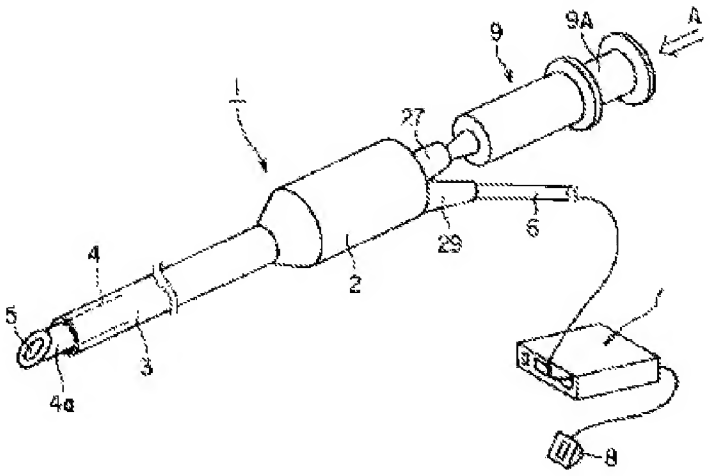

Figure 1

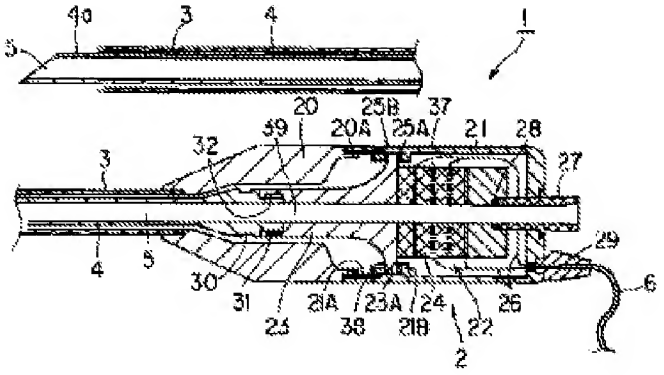

Figure 2

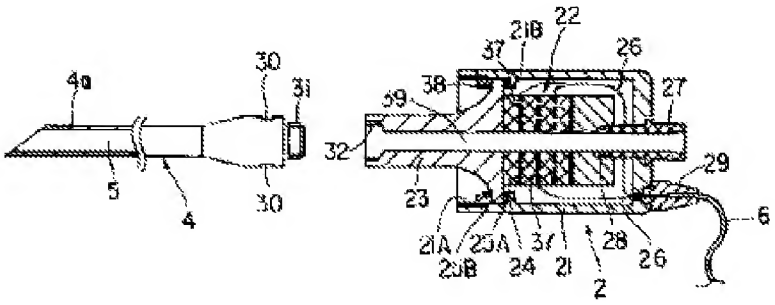

Figure 3

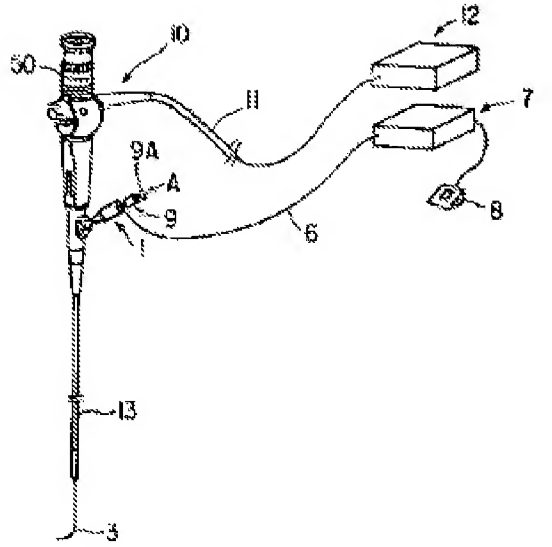

Figure 4

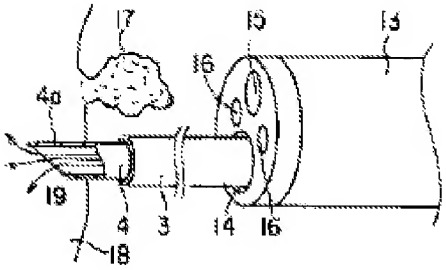

Figure 5

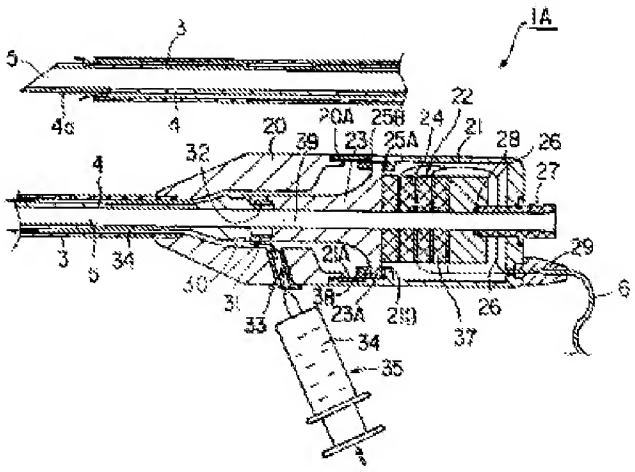

Figure 6